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**FOUR NEW RAJIDS FROM THE GULF OF MEXICO**

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Museum of Comparative Zoology and  
Woods Hole Oceanographic Institution

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Recent otter trawling operations of the U. S. Fish and Wildlife Service vessel "Oregon" in the Gulf of Mexico have yielded four new species of batoids, three of them falling in the genus *Raja* and one in *Cruriraja*. These, added to about a dozen new species of elasmobranchs described from the Gulf during the past seven years, and records of others previously unknown from the western Atlantic, emphasize the richness of the Gulf fauna. We are indebted to Stewart Springer and Harvey R. Bullis, Jr. of the U. S. Fish and Wildlife Service for the opportunity of describing these species. Drawings are by Eugene N. Fischer.

*RAJA OREGONI* sp. nov.

Figures 1, 2

*Study Material.* Mature male, 1440 mm in total length, holotype, U. S. Nat. Mus. No. 156710, and an immature male 1069 mm in total length, paratype, M. C. Z. No. 39617, both from the northern part of the Gulf of Mexico, the holotype from Lat. 29°10'N, Long. 88°13'W, in 205 fathoms, "Oregon" station 1247, the paratype from Lat. 28°32'N, Long. 86°20'W, in 260 fathoms, "Oregon" station 1277.

*Distinctive Characters.* The combination of features distinctive for *oregoni* among hard-nosed skates of the genus *Raja* are: anterior contour of disc deeply concave, with narrowly projecting snout, of the shape pictured in Figure 1; upper surface of pectorals without conspicuous markings of any sort; disc, rearward of the spiracles, without any large thorns, its midbelt bare even of prickles; tail with three rows of large close-set thorns extending to base of first dorsal fin; lower surface with pore openings in head region marked conspicuously with black dots.

<sup>1</sup> Contribution No. 932 from The Woods Hole Oceanographic Institution.

*Comparison with previously known species.* It is only with species sharing the diagnostic features listed in the preceding section that comparison seems called for, a limitation welcome

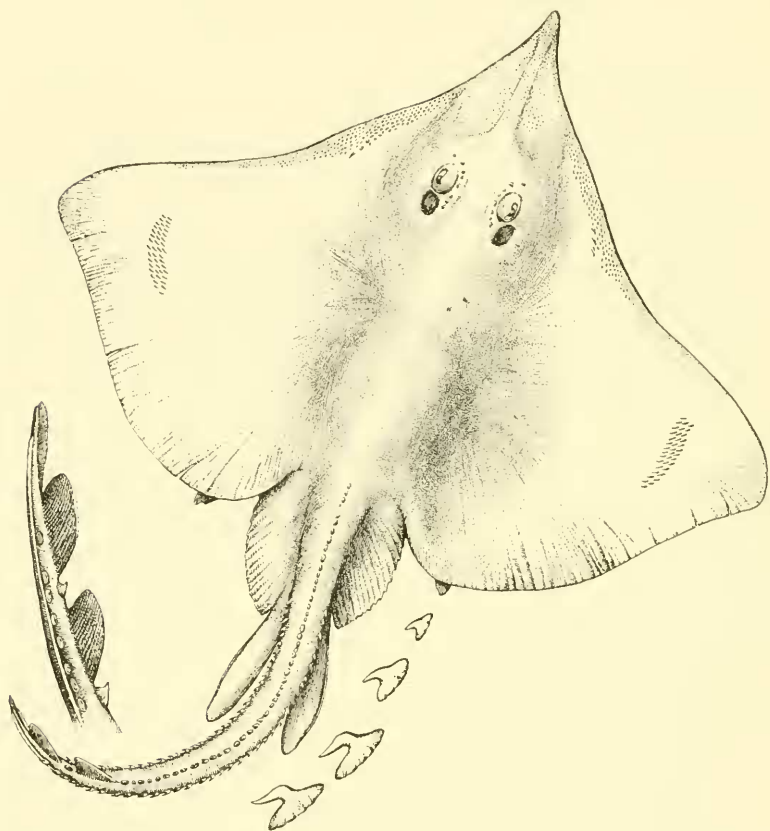


Figure 1. *Raja oregoni*, dorsal view of type, mature male 1440 mm long; end of tail showing dorsal fins and caudal fin about  $\times 0.2$ ; tail thorns from mid row about  $\times 1$ .

because about 110 recognizably distinct species of the genus *Raja* have been named already from one part of the oceans or another (Bigelow and Schroeder 1953, p. 147).



Among the skates known from the North Atlantic (including the Gulf of Mexico) *oregoni* most nearly resembles *laevis* Mitchill 1817, the common barn-door skate of the northeastern American

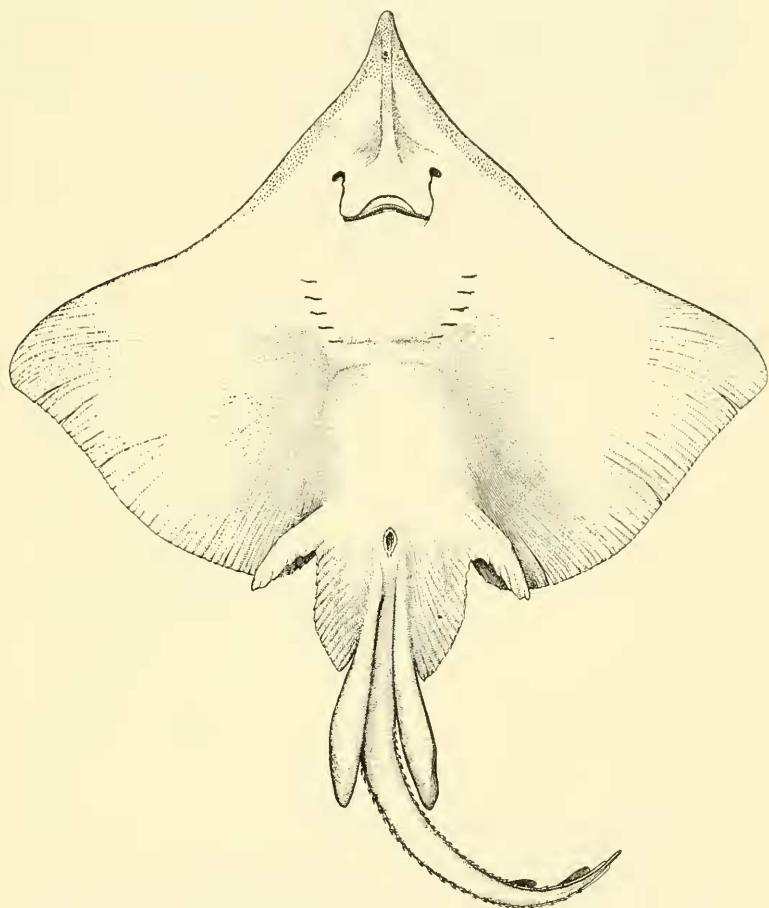


Figure 2. *Raja oregoni*, ventral view of specimen shown in Figure 1.

coast and its eastern Atlantic representative, *batis* Linnaeus 1758. But the thorns on the tail of *oregoni* are much larger than on *laevis* or on *batis*, closer set, and with those on the lateral rows

along the rear half of the tail directed rearward in very characteristic shape (Fig. 1). Other differences are that the snout is noticeably longer in *oregoni* (length anterior to orbits about 4 times as great as the distance between orbits) than in either *laevis* or *batis* (2.4-3 times) in males of about equal size; that the rostral cartilage is narrower and that the black pore markings of the ventral surface are restricted to the area anterior to the abdominal region whereas in *laevis* and in *batis* they are present on the rearward part of the disc as well.

The only other western North Atlantic skates that *oregoni* resembles at all closely in general appearance, combined with thorn pattern, are *R. olseni* Bigelow and Schroeder 1951 and *R. teevani* Bigelow and Schroeder 1951 but there is no danger of confusing it with either of these. Conspicuous respects in which it differs from *olseni* are in a shorter interspace between first and second dorsal fins, with only 1 thorn (3-6 thorns in *olseni*); in a larger number (31 to 48) of thorns in the mid-row on tail (only 13-26 in *olseni*) with the lateral rows closely and regularly spaced (irregularly and widely spaced in *olseni*). Other differences of perhaps equal significance taxonomically, though less noticeable, are that in *oregoni* the expanded outer-posterior margin of the nostrils is smooth edged (fringed in *olseni*, Bigelow and Schroeder 1951, fig. 2B; 1953, fig. 54  $\alpha$  B), that the upper surface of the snout, with the outer-anterior edge of the pectorals, is prickly (smooth in *olseni*), that the nuchal region is naked in *oregoni* but is armed with a strong thorn in large specimens of *olseni*<sup>1</sup> (not, however, on the juveniles). On the other hand, no trace is to be seen on the upper surface of *oregoni* of the white dots marking the pores that are a conspicuous feature of *olseni*, nor has the latter any dark dots on the under surface as is the case in *oregoni*.

*Oregoni* resembles *teevani* closely in anterior contour of its disc but differs in having 3 rows of prominent thorns on the tail (one row on *teevani*), by having a tail which narrows posteriorly as is usual among skates (on *teevani* the posterior half of tail is as wide or wider than the anterior), and by having a space, occupied by a thorn, between its dorsals (dorsals are confluent on *teevani*), and *teevani* lacks dark pores on the under surface.

<sup>1</sup> Specimens at hand include a nearly mature male *olseni* 510 mm long recently collected by "Oregon" in the Gulf of Mexico at Station 1514.

*Oregoni* is set apart, by the combination of characters classed above as "diagnostic," from all hard-nosed skates yet known

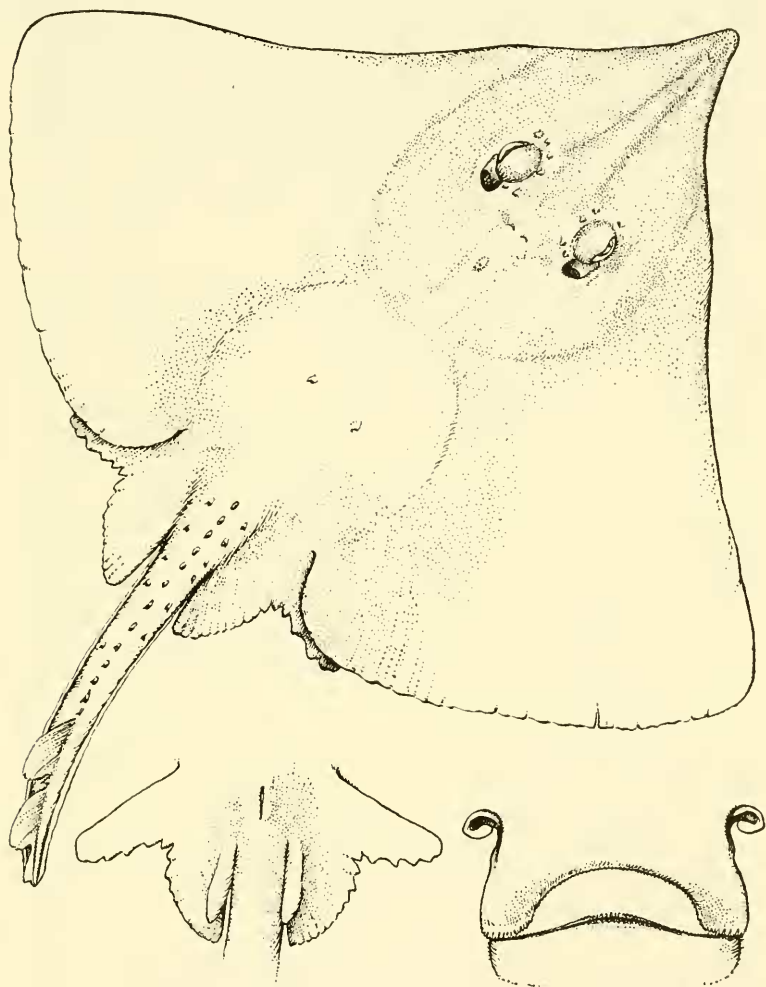


Figure 3. *Raja flavirostris*, immature male 374 mm long, "William Scoresby" station 79, from Lat.  $51^{\circ}01'30''$ S, Long.  $64^{\circ}59'30''$ W, in British Museum (Natural History); pelvic fins about  $\times 0.4$ ; mouth, nostrils and nasal curtain about  $\times 0.8$ .

from the east coast of South America, or from the Magellanic region, with the exception of *R. flavirostris* Philippi 1892 the recorded range of which extends from Argentine and Patagonian waters to Chile. And it differs sharply from half grown and larger *flavirostris*<sup>1</sup> in a conspicuously longer tail (46-50 per cent of total length contrasted with 41.8-42.5 per cent in the half-grown *flavirostris* with which we have compared it; in lacking the large nuchal thorn that is characteristic of *flavirostris*; also in the greater size, more regular spacing, and shape of the thorns in the lateral rows on the tail (cf. Fig. 1 with Fig. 3 of *flavirostris*).

The only skates known from European or tropical west African waters, and from southern Africa, with which *oregoni* shares an outer anterior contour of the shape pictured in Figure 1, combined with a disc that is wholly bare of thorns posterior to the spiracles, but a tail that is armed with 3 regular rows (one median and two laterals) of close-set thorns, are: *Raja batis* Linnaeus 1758, *R. alba* Lacépède 1803 (including *R. marginata* Lacépède 1803, partly grown specimens and some adults), and *R. miraletus* Linnaeus 1758 (some specimens). And it is marked off from all of these by characters that cannot reasonably be credited to variation (whether individual or regional) or explained away on the basis either of sex or of the stage of growth of the particular specimens that have served as the bases for published accounts. Thus it differs from *batis* in the same respects in which it differs from *laevis* of the North American coast (p. 00), and this also applies to the skate that has been reported as *batis* from South Africa (Thompson 1914, p. 156; Barnard 1925, p. 70; Smith 1949, p. 66) though available information regarding the latter is scanty. And while it resembles *alba* of European waters and the skate that has been reported under that name in southern African waters from Walfish Bay on the west around the Cape to Natal on the east, first by von Bonde and Swart (1924, p. 5) both as *alba* and as *stabuliformis*

<sup>1</sup> We are indebted to the British Museum for the loan of three *flavirostris*, a male 374 mm long, a female 353 mm, and a juvenile male of 180 mm. from the series reported upon and pictured by Norman 1937, p. 13, fig. 4.

Garman 1913, next as *marginata* (Barnard 1925, pp. 63, 65), and more recently as *alba* by Smith (1949, p. 66), the skin of the tail of *oregoni* is naked between the thorns (described as "strongly spinulose" for *alba* by Clark, 1926, p. 48), as well as over the inner-posterior parts of the disc as a whole while it is more or less prickly on adults of *alba*. Further, the mid-row of thorns on its tail does not extend forward on to the disc as it does in *alba*, when adult, and the black pore markings characteristic of the lower surface of *oregoni* (Fig. 4) are not present on *alba*. Again, *oregoni* resembles *R. miraletus* in its pointed snout, smoothness of posterior part of disc and presence of 3 rows of thorns on the tail. But its outer anterior contour is much more deeply concave than that of *miraletus*; it lacks the 2 nuchal thorns characteristic of the latter; the number of thorns in each of the rows along is tail is much greater, there being about 50 in the median row on the male pictured in Figure 1, contrasted with 14 pictured by Rey for an adult male of *miraletus* 402 mm long, and 25 recorded by him for a female, not counting those between the dorsal fins (Rey, 1928, p. 573, pl. 13, fig. 2). Also, the interspace between the two dorsals is noticeably shorter in *oregoni* than in *miraletus*; and while black pore marks are present on the lower surface of *oregoni*, they are lacking on *miraletus*. And *oregoni* is much the larger growing member of the pair, it being unlikely that *miraletus* grows longer than about 500 mm, nor does *oregoni* show any signs of the large, light-blue centered eye spots, one of which marks the upper surface of each pectoral of *miraletus*.

It is interesting, in passing, that in the presence of the black pore markings on its lower surface *oregoni* parallels not only *batis*, but also *oxyrhynchus* Linnaeus 1758 (including *macrorhynchus* Bonaparte 1832-41) among European species. But there is no question of specific unity in this case, the snout of *oregoni* being less narrowly pointed than that of *oxyrhynchus* with the outer anterior contour of the disc much less deeply concave; the 3 rows of large tail thorns of *oregoni*, so conspicuous a feature of the adult male, being represented on the adult male *oxyrhynchus* by a single median row of about 8 to 12 thorns; the two dorsal fins separated by an interspace with a thorn in *oregoni*

being confluent at the base, or nearly so, in *oxyrhynchus*; and the black pore marks on the lower surface, which are confined

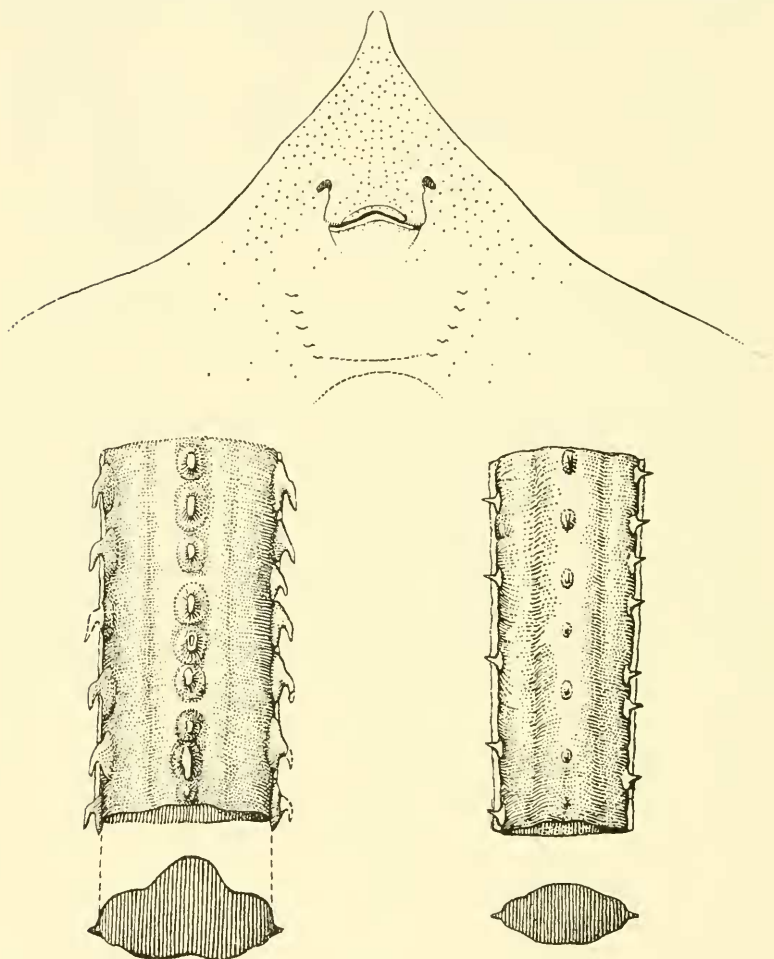


Figure 4. *Raja oregoni*, ventral view of head to show dark mucous pores, about  $\times 0.1$ . Lower left, section of tail from 8th to 16th thorns in mid row, from first dorsal fin, about  $\times 0.5$ , same specimen as in Figure 1. Lower right, *Raja laevis*, section of tail from 3rd to 9th thorns in mid row, from first dorsal fin, about  $\times 0.5$ , a male 1185 mm long from off Nantucket, Massachusetts.



mostly to the head region in *oregoni* being distributed over the abdominal region as well in *oxyrhynchus*.

In its concave outer outlines, with narrow snout, and in the black dots marking the lower surface of its head, *oregoni* most nearly resembles *R. rhina* Jordan and Gilbert 1880 among skates of the west coast of North America. But it differs from *rhina* in lacking the nuchal spine or spines that characterize *rhina*, as well as in the orderly arrangement of the thorns on its tail which on *rhina* are usually arranged irregularly with the rows interrupted. Furthermore, the mid zone of disc from the scapular region on to the tail is smooth on *oregoni* but has a band of small thorns with stellate bases on *rhina*.

Similarly, the narrowness of its "nose" combined with its lack of thorns anywhere on the disc rearward from the spiracles, contrasted with the presence of 3 rows of thorns along the tail, marks off *oregoni* among hard-nosed skates known from the Pacific coast of Central and South America, except *flaviostris* which was originally described from Chile. Respects in which it differs from *flaviostris* are summarized above.

Among the dozen or so narrow-nosed species of *Raja* that have been reported, with adequate published accounts, from the Indo-West Pacific region, three only are described, with a fourth pictured, as with the openings of the pores black-marked on the lower surface, and *oregoni* cannot be identified with any one of these. Thus *oregoni* lacks a nuchal thorn which is present and conspicuous in *australis* Macleay 1884 from Australia and Tasmania and the 3 rows of thorns on the tail of *oregoni* are longer and more regular than in *australis*. While *oregoni* lacks a nuchal thorn and the tail thorns are arranged in regular rows, *tobae* Tanaka 1916 from Japan has 2 thorns on the nuchal region and its 3 rows of tail thorns are irregular. *Oregoni*, lacking thorns along the midline of disc, differs from *porosa* Günther 1874, from the north Chinese coast, which has 3 or 4 conspicuous thorns in that area, and the 3 rows of thorns on the tail of *oregoni* distinguish it from *gudgeri* Whitley 1940, from Western Australia, which has but a single row as well as a much longer snout.

Neither can *oregoni* be referred to any of the other Indo-West Pacific species that it resembles at all closely in the anterior contour of its disc, for no known member of this group parallels

*oregoni* in the presence of three regular rows of large close-set thorns extending from the base of the tail rearward as far as the first dorsal fin, but combined with a total lack both of thorns and of prickles on the mid belt of the disc posterior to the spiracles. While it agrees with *macracauda* Ishiyama 1955 from Japan in shape of snout and disc and also in presence of dark pores below,<sup>1</sup> it differs from *macracauda* in having 3 rows of thorns on the tail (only 1 row in *macracauda*).

*Description of holotype.* Proportional dimensions in per cent of total length:<sup>2</sup>

Disc. — Extreme breadth 69.8; length 53.2.

Snout length. — In front of orbits 17.4; in front of mouth 18.5.

Orbits. — Horizontal diameter 2.8; distance between 4.5.

Spiracles. — Length 2.1; distance between 6.4.

Mouth. — Breadth 8.0.

Exposed nostrils. — Distance between inner ends 8.3.

Gill openings. — Length, 1st 1.4; 3rd 1.8; 5th 1.2; distance between inner ends, 1st 13.8; 5th 8.1.

First dorsal fin. — Vertical height 1.5; length of base 3.6.

Second dorsal fin. — Vertical height (damaged); length of base 3.8.

Pelvises. — Anterior margin 10.9.

Distance. — From tip of snout to center of cloaca 50.0; from center of cloaca to 1st dorsal 37.2; to tip of tail 50.0; from rear end of 2nd dorsal base to tip of tail 4.2.

Interspace between. — 1st and 2nd dorsals 1.3.

Disc nearly 1.4 times as broad as long, maximum angle in front of spiracles about 72°; anterior margins sinuous, being rather strongly concave from tip of snout to opposite orbits where they are slightly convex, hence again concave, this second concavity culminating about three-fifths the distance between tip of snout and outer corners of disc which are sharply rounded; posterior margins about straight near outer corner, then gently rounded, as is inner margin. Axis of greatest breadth about 72 per cent back from tip of snout to axils of pectorals. Tail with a

<sup>1</sup> Two young specimens examined by us, through the kindness of Dr. Ishiyama.

<sup>2</sup> The measurements from which the proportional dimensions have been calculated were taken on a horizontal line between perpendiculars at given points (see Bigelow and Schroeder 1953, fig. 1 and p. 4).



narrow lateral fold, low down on each side, beginning almost imperceptibly beyond level of tips of pelvics by a distance equal to about twice the interorbital width, widening posteriorly and continuing almost to extreme tip of tail being much the widest opposite dorsals and caudal membrane; length of tail from center of cloaca to origin of first dorsal fin 0.75 times as great, and to its tip equal to distance from center of cloaca to tip of snout.

A row of 7 or 8 small thorns along inner margin of each orbit, ending about opposite middle of spiracle. End of snout covered with coarse prickles; smaller prickles over rostral process, on translucent areas in front of orbits and in space between orbits. A band of small thorns and coarse prickles extends along edge of disc beginning rearward from tip of snout by a distance about equal to that between spiracles, and ending a little in advance of alar thorns, being coarsest in the area opposite and a little posterior to the spiracles. No thorns in the scapular region. A median row of about 48 thorns beginning on tail opposite axils of pectorals and extending to first dorsal fin, of unequal sizes, some with points directed obliquely rearward, others with points broken or worn; a row of thorns low down on each side of the median row, beginning a little in advance of tips of pelvics and ending opposite second dorsal fin, 31 on the left and 34 on the right, those with points still intact directed rearward parallel, or nearly so, to axis of tail; 1 thorn between dorsals. Alar thorns prominent, in two to four rather regular rows, 43 on left side of disc, 38 on right, rest of body, pelvics and tail smooth, including dorsal fins and skin over eyes. A short row of 9 or 10 mucous pores in nuchal region on each side, parallel to midline, at a distance from it equal to about two-thirds length of orbit, the pores not ringed with dark as conspicuously as on *garricki*. Lower surface with prickles in front of and aside the mouth, densest toward end of snout and along margins of disc where they extend rearward about one-half the distance toward outer angle of pectoral; a few minute prickles scattered on disc between mouth and fifth pair of gill openings; rest of lower surface naked.

Snout in front of orbits 6 times as long as orbit, its length in front of mouth 2.2 times as great as distance between exposed nostrils. Distance between orbits about 1.6 times as great as length of orbit. Orbit 1.3 times as long as spiracle. Nasal curtain fringed; expanded posterior (outer) margin of nostrils smooth, without fringes. Upper and lower jaws strongly arched centrally. Teeth  $\frac{36}{33}$ , more nearly in longitudinal rows than in quincunx, with circular or ovate base, those in upper jaw in median sector of mouth with a prominent narrow upright cusp, the adjacent teeth pointing very slightly toward corner of mouth where the cusps become low triangular; lower teeth similar.

Distance between first gill openings 1.7 times as great as between exposed nostrils; between fifth openings 0.97 times; first gill openings 1.2 times as long as fifth and about 0.2 as long as breadth of mouth. First and second dorsals similar in size and perhaps in shape (second dorsal damaged). Interspace between dorsals 0.36 times as long as base of first dorsal. Second dorsal confluent with caudal membrane. Caudal membrane base equal to first dorsal base. Pelvies deeply concave, strongly scalloped along anterior side of excavation, moderately so rearward; anterior margin 0.74 times as long as distance from its own origin to rear tip of pelvic; anterior lobe slender, including four radial cartilages besides the first stout one; posterior lobe moderately convex, with a narrowly rounded tip, extending 0.36 times the distance from axil of pectorals toward first dorsal. Claspers reaching beyond tips of pelvies by a distance equal to seven-tenths the distance from front of orbits toward tip of snout.

*Color.* Upper surface brownish, without spots or other markings. Lower surface pale bluish-gray on disc, pelvies and claspers; tail pale brown; scattered black pores anterior to abdominal region, most numerous around mouth and in front of level of mouth to near tip of snout.

The other known specimen of this species, an immature male 1069 mm long, differs in the following respects. The disc is about 1.3 times as broad as long; maximum angle in front of spiracles  $70^\circ$ ; axis of greatest breadth 70 per cent back from tip of snout toward axils of pectorals. The tail is relatively shorter, the distance from center of cloaca to its tip being 0.85 times the distance from center of cloaca to tip of snout. Because of the relatively

shorter tail on the immature male, the snout is longer relative to total length (21.5 per cent to eye and 23.2 per cent to mouth opening, compared with only 17.4 and 18.5 per cent, respectively, for the mature male), the disc proportionately wider, and longer (76.5 per cent and 57.2 per cent, compared with 69.8 and 53.2 per cent, respectively, for the larger male). There are 5 small thorns along inner margin of each orbit and 1 or 2 immediately in front of orbit; fewer prickles on end of snout; and the anterior edge of the disc is smooth. The median row of thorns on tail numbers 31, the side rows 24 on the left and 22 on the right, these latter ending opposite first dorsal fin and there is no thorn between the dorsals. On the lower surface the prickles along the margins of disc extend rearward about three-fifths the distance toward outer angle of pectoral. The snout in front of orbits is 7 times as long as orbit, its length in front of mouth 2.5 times as great as distance between exposed nostrils. The jaws are less strongly arched and there are  $\frac{38}{34}$  teeth, with low triangular cusps, only those near outer corners being slightly oblique.

The second dorsal, which is undamaged on this specimen, is similar to the first in shape but with a slightly shorter base and the interspace between the dorsals is relatively shorter, being about 0.14 times as long as the base of first dorsal. The anterior margin of the pelvic is almost as long as the distance from its own origin to rear tip of pelvic and the posterior lobe extends 0.31 times the distance from the axils of pectorals toward first dorsal. The claspers fail to reach the tips of the pelvics by a distance equal to length of fifth gill opening.

Known only from the offing of Cape San Blas, Florida, in 205-260 fathoms. Named in recognition of the fishery explorations of U. S. Fish and Wildlife Service vessel "Oregon" in the Gulf of Mexico and the Caribbean Sea.

RAJA GARRICKI sp. nov.

Figures 5, 6, 7

*Study Material.* Mature male, 975 mm in total length, holotype, U. S. Nat. Mus. No. 156711, and another male 1019 mm in total length, paratype, M. C. Z. No. 39616, both from the northern part of the Gulf of Mexico, Lat.  $28^{\circ}32'N$ , Long.  $86^{\circ}20'W$ , in 260 fathoms, "Oregon" station 1277.

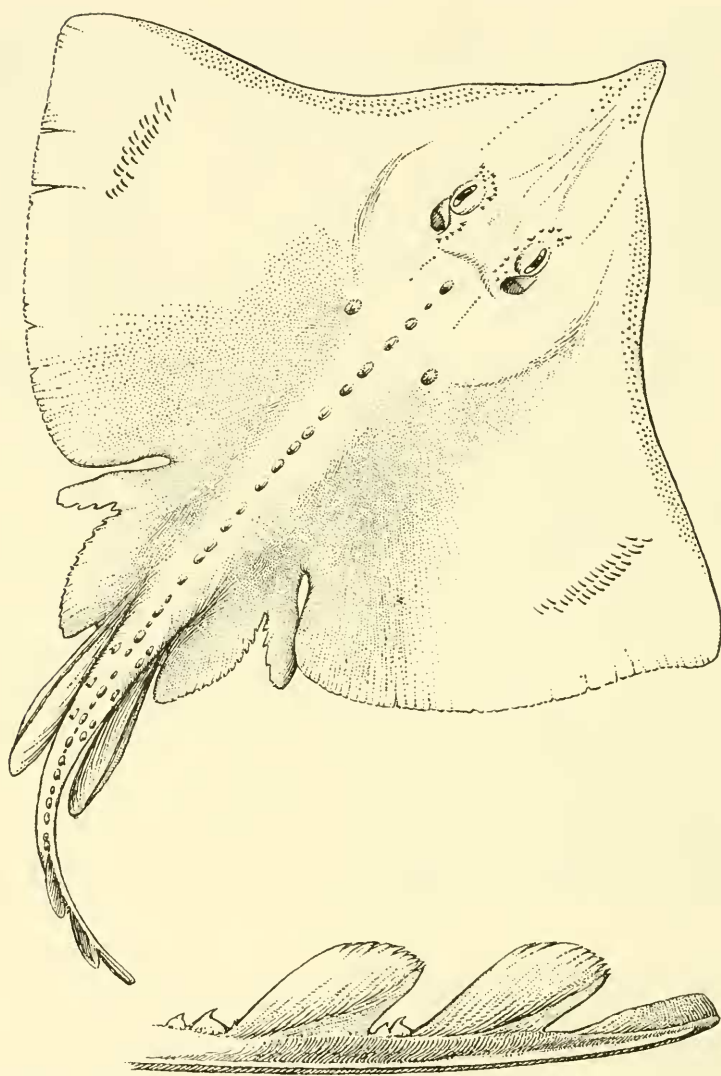


Figure 5. *Raja garricki*, dorsal view of type, mature male 975 mm long; end of tail showing dorsal fins and caudal fin, about  $\times 0.5$ .

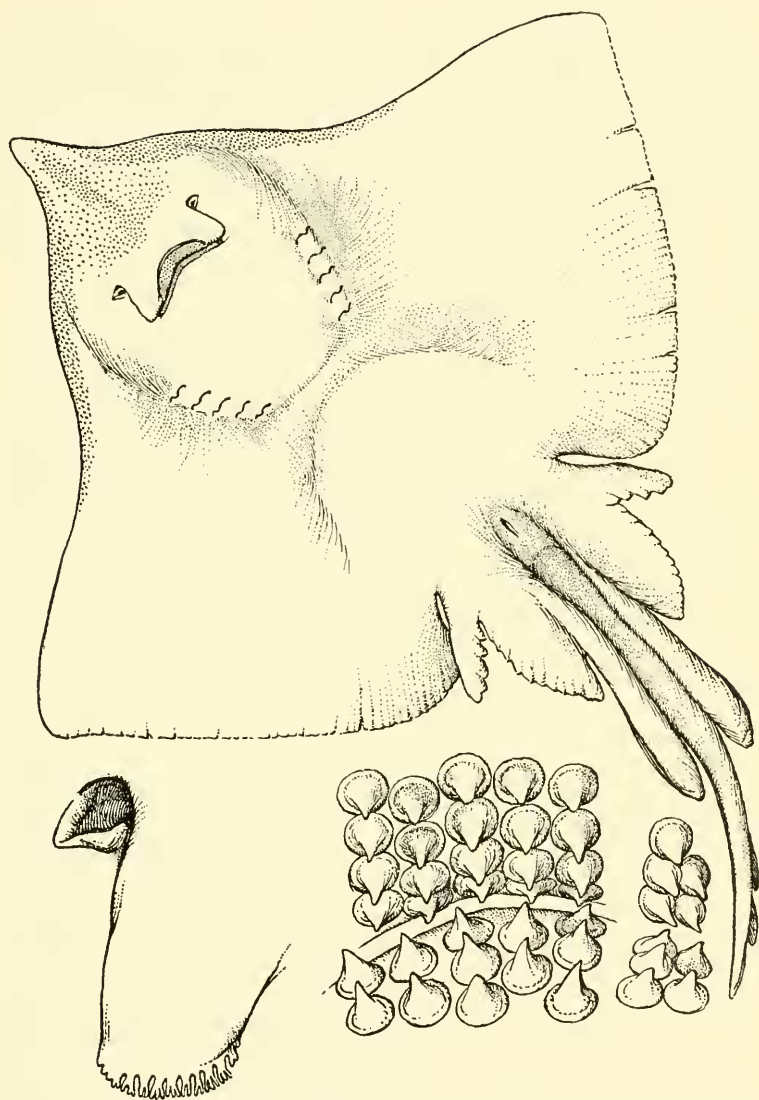


Figure 6. *Raja garricki*, ventral view of specimen shown in Figure 5; right hand nostril and nasal curtain, about  $\times 1$ ; upper and lower teeth from center and from near outer part of jaws, about  $\times 2.4$ .

*Distinctive Characters.* Characters in combination which distinguish *garricki* from other species of the genus *Raja* are: margins of disc anterior to outer angles of pectorals sinuous (at least in the males, the female has not been seen); snout pointed (Fig. 5); disc with a single row of large thorns along the midbelt extending from the nuchal region to the first dorsal fin, with an interrupted row on either side on the tail; a single large scapular thorn on each side of the midrow; lower surface with dark mucous pores anterior to the abdominal region (Fig. 7).

*Comparison with previously known species.* The only western Atlantic skates with a disc somewhat the shape of *garricki* and with dark pores on the under surface are *laevis*, *oregoni*, *flavirostris*, *platana* Günther 1880 and *agassizi* Müller and Henle 1841. But *garricki* differs from all of these (excepting some specimens of *agassizi*) by having a continuous row of thorns along the mid-line of disc and tail, extending from the nuchal region to the dorsals whereas the midrow of thorns on the above mentioned species does not extend much, if any, forward beyond the axils of the pectorals. And *garricki* may be distinguished from *agassizi* by the position of its first dorsal which originates much nearer to tip of tail than to tips of pelvies (nearer pelvies than tip of tail on *agassizi*) and by a dorsal fin interspace much shorter than base of either first or second dorsal. Also, the dark pores on the under surface of *garricki* are much more conspicuous and more numerous than on *agassizi*.

In the eastern Atlantic, including southern Africa, only *batis* and *oxyrhynchus* have a narrow snout together with dark pores below, and both of these lack the thorns along the midline of the disc that are present on *garricki*.

*Garricki* falls with *rhina* and *flavirostris* of the eastern Pacific in general shape of disc and in the presence of dark pores below. But *garricki* differs in spination from *rhina* by having scapular thorns and a single row of midline thorns on the disc but no additional small thorns in the midzone. *Flavirostris* has one nuchal thorn but no other midline thorns on disc.

*Garricki* somewhat resembles *lempriei* Richardson 1844-48, *porosa* Günther 1874, and *australis* Macleay 1884 in the Indo-Australian region in having a narrow snout and dark pores



(Munro 1956, p. 15) on the lower surface but its row of thorns along the midzone of disc sets it apart from these species which lack thorns in this area and from *gudgeri* Whitley 1940 which has but a very short row along the middle of the back as well as a very long and narrow snout resembling that of *oxyrhynchus*. *Garrieki* closely resembles *macracauda* Ishiyama 1955 from Japan in shape of disc and in having dark pores below but, except for 2 nuchals, *macracauda* lacks thorns along the midline of disc and has no scapular thorns.

*Description of holotype.* Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 78.3; length 59.0.

Snout length. — In front of orbits 18.3; in front of mouth 19.0.

Orbits. — Horizontal diameter 3.5; distance between 5.4.

Spiracles. — Length 3.1; distance between 6.9.

Mouth. — Breadth 8.5.

Exposed nostrils. — Distance between inner ends 9.1.

Gill openings — Length, 1st 1.5; 3rd 1.8; 5th 1.5; distance between inner ends, 1st 15.7; 5th 9.4.

First dorsal fin. — Vertical height 2.8; length of base 4.0.

Second dorsal fin. — Vertical height 2.6; length of base 3.7.

Pelvies. — Anterior margin 10.6.

Distance. — From tip of snout to center of cloaca 55.4; from center of cloaca to 1st dorsal 30.7, to tip of tail 44.6; from rear end of 2nd dorsal base to tip of tail 5.0.

Interspace between. — 1st and 2nd dorsals 1.2.

Disc about 1.3 times as broad as long, maximum angle in front of spiracles about  $78^{\circ}$ ; anterior margins weakly concave just posterior to tip of snout, thence slightly convex followed by a stronger concavity culminating about midway between tip of snout and outer corners which are sharply rounded; posterior margins at first about straight from outer corner, then gently rounded, as is inner margin. Axis of greatest breadth about 62 per cent of distance back from tip of snout toward axils of pectorals. Tail with a narrow lateral fold, low down on each side, beginning abruptly in advance of tips of pelvies by a distance equal to about three-fourths the interorbital width and continuing almost to extreme tip of tail, widest opposite dorsals

and caudal membrane; length of tail from center of cloaca to origin of first dorsal fin 0.56 times as great, and to its tip 0.80 times as great, as distance from center of cloaca to tip of snout.

A patch of 11 small thorns immediately in front of left orbit and 7 in front of right followed by a row of 7 or 8 larger thorns along inner margins of orbits ending slightly posterior to rear margins of spiracles. End of snout densely covered with small thorns and prickles extending rearward over rostral process in diminishing numbers; a band of small thorns and prickles extends along edge of disc from tip of snout to about opposite foremost alar thorns, narrow near end of snout, then widening and the prickles coarsening half way from snout to opposite orbits, again smaller rearward. A single stout thorn on each side of median row in scapular region; a median row of prominent thorns from nuchal region to first dorsal fin, of which 4 are in the nuchal-scapular area, the second of these being very small, followed by 32 thorns of which 7 are anterior to pectoral axil and 25 on tail, these latter somewhat closer together and more uneven in size; a row of 3 large thorns aside the median row on left side of the mid-tail region and 5 on the right side, unevenly spaced; 2 prominent thorns between dorsal fins. All the thorns on body and tail that have retained their sharp points are directed obliquely rearward. Alar thorns prominent, in two to three irregular rows, 26 on left side of disc, 30 on right; rest of body, pelvics and tail smooth as is space between orbits and skin over eyes; first and second dorsals with a few scattered prickles.

A short longitudinal row of 11 dark pigmented mucous pores on the right side of first nuchal thorn and of 8 on the left side, at a distance from the midline about two-thirds as great as diameter of orbit. The presence of mucous pores, in a conspicuous pattern in this region, has thus far been found only on *Raja fyllae* Lütken 1887, *laevis* and in the new species *oregoni* and *clarkii* among skates known from the western North Atlantic. (See Bigelow and Schroeder, 1954, p. 57.)

Lower surface with prickles in front of and aside the mouth, most dense toward end of snout and along margins of disc where they extend rearward about three-fifths the distance toward outer



angle of pectoral; a few exceedingly small widely scattered prickles over parts of the scapular and abdominal regions and on pelvies; rest of lower surface naked.

Snout in front of orbits 5.2 times as long as orbit, its length in front of mouth 2.1 times as great as distance between exposed nostrils. Distance between orbits about 1.6 as great as length of orbit. Orbit 1.1 as long as spiracle. Nasal curtain fringed; expanded posterior (outer) margins of nostrils smooth, without fringes. Upper and lower jaws strongly arched centrally. Teeth  $\frac{35}{35}$  more nearly in quincunx arrangement than in longitudinal rows, with circular or ovate base, those in upper jaw in median sector of mouth with a prominent upright cusp, the adjacent teeth with cusps pointing toward corner of mouth, those near corners of mouth with flattened crowns; lower teeth similar but median teeth with cusps at slight angle, which increases outwardly.

Distance between first gill openings 1.7 times as great as between exposed nostrils; between fifth openings 1.0 times; first gill openings 1.1 times as long as fifth and about 0.2 as long as breadth of mouth. First and second dorsals similar in size and shape. Interspace between dorsals 0.33 as long as base of first dorsal. Caudal membrane base equal to that of first dorsal. Pelvies deeply concave, strongly scalloped along anterior side of excavation, moderately so rearward; anterior margin 0.58 as long as distance from its own origin to rear tip of pelvie; anterior lobe slender, including four radial cartilages beside the first stout one; posterior lobe moderately convex, with a narrowly rounded tip, extending about one-half the distance from axil of pectorals toward first dorsal. Claspers reaching beyond tips of pelvies by a distance equal to seven-tenths the distance from front of orbits toward tip of snout.

Rostral cartilage firm, extending nearly to tip of snout. Anterior pectoral rays reaching about three-sevenths the distance from front of orbits toward tip of snout.

*Color.* Upper surface plain brownish without spots or other markings. Lower surface pale bluish dusky on disc, pelvies and claspers, tail tending more to pale brownish. Scattered black

pores anterior to abdominal region, most numerous around mouth and in front of level of mouth to near tip of snout. (Fig. 7.)

The other known specimen of this species, a male 1019 mm long, differs as follows: maximum angle of disc in front of spiracles  $74^{\circ}$ , axis of greatest breadth about 67 percent of distance back from tip of snout toward axils of pectorals; length of tail from center of cloaca to origin of first dorsal fin is 0.53 times as great and to its tip 0.78 times as great as from center of cloaca to tip of snout. There is a patch of 8 small thorns along anterior edge of each orbit; fewer prickles over rostral process which is

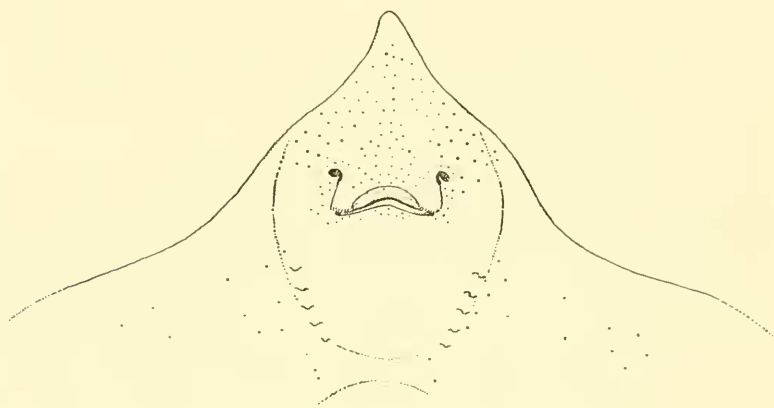


Figure 7. *Raja garricki*, ventral view of head to show dark mucous pores, about  $\times 0.1$ .

naked toward orbits; 5 thorns in the mid row in the nuchal-scapular area, followed by 41 thorns to first dorsal, of which 8 are anterior to pectoral axils and 33 are on tail; a row of 5 unevenly spaced large thorns on left side of tail aside the median row, 2 on right; 31 alar thorns on left and 33 on right side of disc. The mucous pores in nuchal region are in a series of 9 on each side. On the lower surface the prickles along the anterior margin of disc extend less than halfway toward outer angle of pectoral.

Known only from the offing of Cape San Blas, Florida, in 260 fathoms. Named for Dr. J. A. F. Garrick of Victoria University College, Wellington, in recognition of his work on elasmobranchs of New Zealand.

RAJA CLARKII sp. nov.

Figures 8, 9

*Study Material.* Immature male, 665 mm in total length, holotype, U. S. Nat. Mus. No. 156712, another male 580 mm long, and a female 747 mm long, paratypes, M. C. Z. No. 39618, all from the northern part of the Gulf of Mexico, Lat. 28°32'N, Long. 86°20'W, in 260 fathoms, "Oregon" station 1277.

*Diagnostic Features.* The presence of 1 to 3 pairs of prominent white roundish or barlike markings on the upper surface of disc in combination with a broad snout and a band of formidable and very sharp thorns which extend along the lower surface from the tip of snout almost to the extreme outer margin of pectorals sets off *clarkii* from all other known members of the Rajidae.

*Description of holotype.* Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 68.7; length 55.0.

Snout length. — In front of orbits 14.2; in front of mouth 15.3.

Orbits. — Horizontal diameter 3.2; distance between 3.6.

Spiracles. — Length 3.3; distance between 6.0.

Mouth. — Breadth 8.7.

Exposed nostrils. — Distance between inner ends 4.5.

Gill openings. — Length, 1st 1.2; 3rd 1.6; 5th 1.3; distance between inner ends, 1st 14.9; 5th 8.9.

First dorsal fin. — Vertical height 1.7; length of base 4.3.

Second dorsal fin. — Vertical height 1.7; length of base 4.3.

Pelvics. — Anterior margin 11.7.

Distance. — From tip of snout to center of cloaca 53.4; from center of cloaca to 1st dorsal 34.6; to tip of tail 46.6; from rear end of 2nd dorsal to tip of tail 3.2.

Interspace between. — 1st and 2nd dorsals 0.6.

Disc about 1.25 times as broad as long; outline of snout as in Figure 8; anterior margin rather strongly convex in front of orbits, thence concave with outer corners broadly rounded; pos-

terior and inner margins gently rounded. Axis of greatest breadth about 70 per cent of distance back from tip of snout

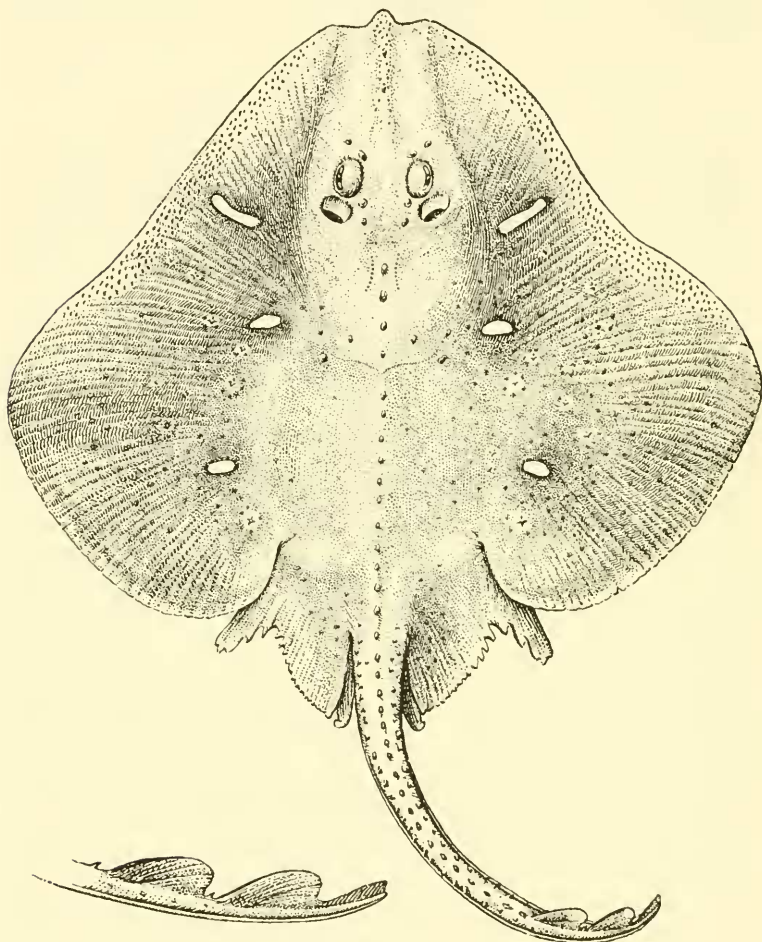


Figure 8. *Raja clarkii*, dorsal view of type, immature male 665 mm long; end of tail showing dorsal fins and caudal fin, about  $\times 0.5$ .

to axils of pectorals. Tail with a narrow lateral fold, low down on each side, beginning just beyond tips of pelvics and continu-

ing almost to extreme tip of tail, widening posteriorly, widest opposite dorsals; length of tail from center of cloaca to origin of

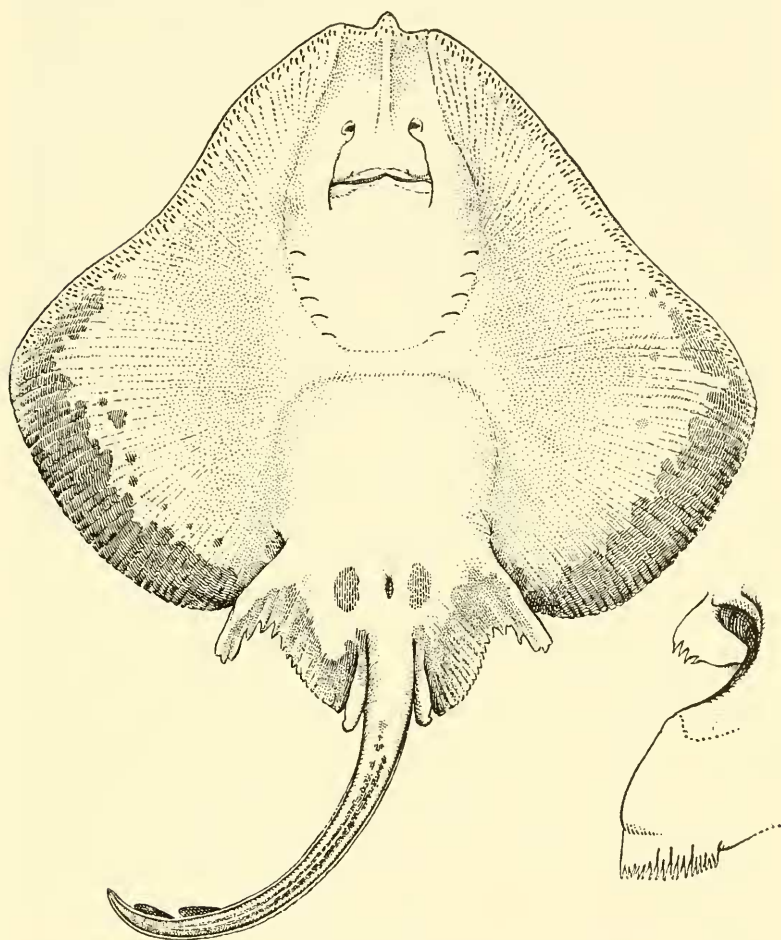


Figure 9. *Raja clarkii*, ventral view of specimen shown in Figure 8; right-hand nostril and nasal curtain, about  $\times 1.1$ .

first dorsal fin 0.65 times as great and to its tip 0.87 times as great as distance from center of cloaca to tip of snout.

A small thorn in advance of each orbit by a distance of about  $\frac{1}{3}$  orbit's diameter; a larger thorn immediately next to inner anterior edge of orbit, with one at posterior end of orbit and another smaller one inward toward median line, this last opposite rear end of spiracle. Snout and disc in front of orbits and space between orbits with small thorns, many with stellate bases, and with prickles; two stouter thorns over rostral process, located 27 and 47 per cent, respectively, in the distance from tip of snout toward orbits; a band of small thorns extends along edge of disc from near tip of snout to about opposite scapular region. A triangular patch of three thorns on each side of median row in scapular region; a median row of 34 thorns from nuchal region to first dorsal, of which 4 are in the nuchal-scapular area, followed by 7 anterior to pectoral axils and by 23 on tail, all of these of about equal size and equally spaced; a row of thorns on each side of the median row beginning about opposite axils of pelvises and continuing to opposite first dorsal, many with sharp hooked points directed rearward; 1 thorn between dorsals. Alar thorns not yet exposed; rest of disc with scattered prickles, very sparse in some areas and mostly minute; also small thorns and prickles on tail in addition to the three prominent rows, mostly low down, from near axils of pelvises nearly to tip of tail; pelvises smooth; dorsals with an occasional prickle. A longitudinal row of 12 dark ringed mucous pores on right side and 13 on left outward from first nuchal thorn by a distance about one-third the diameter of orbit.

Lower surface with prickles along rostral process out to tip of snout with a few scattered over translucent area in front of nostrils; also a band of strong, very sharp thorns all of about the same size, curving inward or obliquely rearward, extending from near end of snout almost to outer angle of pectoral, in a band about 0.4 times as wide as distance between orbits, these characters in combination being a striking feature of this species; rest of lower surface smooth.

Snout in front of orbits 4.4 times as long as orbit, its length in front of mouth 3.4 times as great as distance between exposed nostrils. Distance between orbits about 1.1 as great as length of orbit. Orbit about the same length as spiracle. Nasal curtain fringed; expanded posterior (outer) margins of nostrils with a



few fringes. Upper and lower jaws moderately arched. Teeth  $\frac{63}{31}$ , in part in longitudinal rows and in part more or less in quincunx, with rounded base and triangular cusp, inclined toward corners of mouth.

Distance between first gill openings 3.3 times as great as distance between exposed nostrils; between fifth openings 2.0 times; first gill openings about as long as fifth and about 0.14 as long as breadth of mouth. First and second dorsals similar in size and shape. Interspace between dorsals 0.14 as long as base of first dorsal. Caudal membrane with base a little shorter than that of first dorsal base. Pelvics deeply concave, strongly scalloped along anterior side of excavation, moderately so rearward; anterior margin 0.78 as long as distance from its own origin to rear tip of pelvic; anterior lobe slender, including four radial cartilages besides the first stout one; posterior lobe moderately convex, with a narrowly rounded tip, extending a little less than half the distance from axils of pectorals toward first dorsal. Claspers reaching beyond tips of pelvics by a distance equal to less than half diameter of orbit.

Rostral cartilage firm, extending nearly to tip of snout. Anterior pectoral rays reaching anterior edge of disc but falling short of end of rostral cartilage which continues into snout protuberance.

*Color.* Upper surface pale brown with darker punctulations scattered over disc, pelvics and more or less of tail. Three pairs of prominent white markings on disc, of which one pair is opposite spiracles, bar-like, somewhat eurved, and a little longer than interorbital space; a second pair about half as long and opposite scapular region and a little closer together than first pair; a third pair about size of second pair, in line with first pair and opposite eighth thorn from nape in median series. Lower surface white with a wide irregular grayish band along posterior and inner margins, extending from a little in advance of outer angles to axils of pectorals and along rear margin of pelvics; also a pair of grayish spots opposite cloaca and a few small ones here and there on disc, with some gray markings on tail and on claspers.

The other two known specimens of this species, a male 580 mm long and a female of 747 mm agree very closely with the holotype

in proportional dimensions and in the formidable band of sharp thorns on the under surface along the anterior margin of the disc. The chief differences are as follows. They have a disc 1.2 times as wide as long, and 65.3 and 65.0 per cent, respectively, of the total length of the specimens, as compared with 1.25 times as wide and 68.7 per cent as long as the holotype, while the length of tail from center of cloaca to origin of dorsal fin is 0.69 times as great and to its tip 0.90 times as great as distance from center of cloaca to tip of snout on both specimens as compared with 0.65 and 0.87 times, respectively, on the holotype. The two thorns over the rostral process on the 580 mm male are located 34 and 58 per cent in the distance from tip of snout to orbits while the 747 mm female has three such thorns located 23, 44, and 60 per cent in this distance. There are 40 thorns in the median row on the 580 mm male of which 28 are posterior to the pectoral axil, and there are 38 thorns on the 747 mm female of which 27 are posterior. The mucous pores number 9 on one side and 11 on the other on the smallest skate and 14 on each side of the largest which also has more numerous prickles on lower surface over the translucent area in front of nostrils than on the other two specimens. The tooth count of the 580 mm male is  $\frac{61}{59}$ , and of the 747 mm female  $\frac{60}{60}$ .

The upper surface of the female has the three pairs of prominent white markings of about the same relative size and location as on the holotype but below there are no gray spots in the cloacal region while there is an oval gray spot on each side of the rostral process near its tip. The small male has only one pair of white spots above, opposite the spiracles, roundish, and about half the size of the orbit.

Known only from the northern part of the Gulf of Mexico, Lat. 28°32'N, Long. 86°20'W, in 260 fathoms. Named for Robert S. Clark in recognition of his revision of European skates and rays.

CRURIRAJA RUGOSA sp. nov.

Figures 10, 11

*Study Material.* Immature male, 367 mm in total length, holotype, U. S. Nat. Mus. No. 156713 from the northeastern part of the



Gulf of Mexico, in 200-300 fathoms, trawled by the "Oregon," station number not known.

*Distinctive Characters.* *Cruriraja rugosa* differs from all other known members of its genus in that the under side of its tail is covered with minute prickles, this area being smooth in all other species.

*Comparison with previously known species.* From other western Atlantic species it differs as follows: from *atlantis* Bigelow and Schroeder 1948, by the short space between its dorsals, equal to about one-fourth the length of first dorsal base (about  $2\frac{1}{2}$  times the dorsal base on *atlantis*); from *poeyi* Bigelow and Schroeder 1948, by its prickles on disc, the presence of two nuchal thorns and of a single row of thorns on the midline of tail (disc without prickles, no nuchal thorns, midline row of thorns on tail divides into two rows posteriorly on *poeyi*). It differs from the two species of *Cruriraja* known from South Africa, as follows: from *parmomaculata* (von Bonde and Swart 1924, p. 9, pl. 21, fig. 2) in having a wide space lacking thorns along the midline of disc between the 2 nuchal thorns and axils of pectorals, by lacking scapular thorns, and by its plain coloration (*parmomaculata*, described from a young specimen 181 mm in total length, has a continuous row of thorns from the nuchal region to the first dorsal, 1 scapular thorn on each side and 14-18 blackish brown spots of varying size on the disc). *Rugosa* with its widely interrupted row of thorns along the midline of back, its lack of thorns in the scapular region and the rounded rear margins of its dorsal fins may be readily distinguished from *durbanensis* (von Bonde and Swart 1924, p. 11, pl. 22, fig. 1) which has an uninterrupted row of thorns along the midline of back from nape of first dorsal on a male 232 mm long, 2 scapular thorns on each shoulder and dorsal fins which are pointed posteriorly; and on a female 311 mm long the midrow of thorns ends about halfway along tail, leaving a wide thornless space before first dorsal.

*Description of holotype.* Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 59.4; length 46.0.

Snout length. — In front of orbits 12.0; in front of mouth 15.0.

Orbits. — Horizontal diameter 4.5; distance between 2.8.

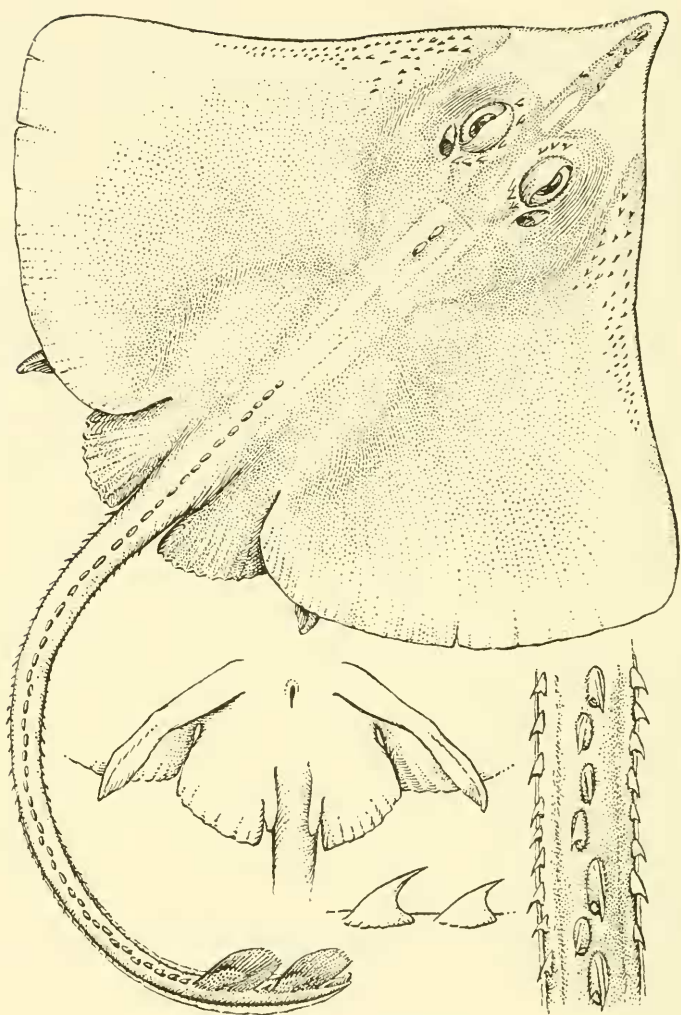


Figure 10. *Cruriraja rugosa*, type, immature male 367 mm long; pelvic fins about  $\times 0.5$ ; section of tail about  $\times 2$ ; first 2 thorns in front of dorsal fin about  $\times 3$ .

Spiracles. — Length 2.2; distance between 6.5.

Mouth. — Breadth 6.3.

Exposed nostrils. — Distance between inner ends 5.5.

Gill openings. — Length, 1st 1.5; 3rd 1.5; 5th 1.2.

First dorsal fin. — Vertical height 2.7; length of base 4.5.

Second dorsal fin. — Vertical height 2.6; length of base 3.3.

Pelvics. — Length of limb 15.0.

Distance. — From tip of snout to center of cloaca 40.6; from center of cloaca to 1st dorsal 48.0; to tip of tail 59.4; from rear end of 2nd dorsal base to tip of tail 2.5.

Interspace between. — 1st and 2nd dorsals 1.1.

Disc about 1.3 times as broad as long, maximum angle in front of spiracles about  $87^{\circ}$ ; anterior margins from snout to outer corners of pectorals slightly sinuous, the corners abruptly rounded; posterior and inner margins gently rounded. Axis of greatest breadth about 70 per cent of distance back from tip of snout to axils of pectorals. Tail with a lateral fold, low down on each side beginning about 55 per cent of the distance from straight. Teeth  $\frac{43}{42}$ , arranged in quincunx, with ovate base and axils of pelvics toward tip of tail, very narrow anteriorly but widening considerably on approaching tip of tail; length of tail from center of cloaca to origin of first dorsal 1.2 times as great and to its tip 1.45 times as great as distance from center of cloaca to tip of snout.

Inner margin of left orbit with 6 thorns, 2 of which are anterior, 1 midway and 3 posterior; right orbit with 3 anterior and 3 posterior thorns, the last two in each case being opposite the spiracles. A staggered row of 4 thorns on anterior part of rostral process followed by a pair of rostral thorns a little more than half the distance from tip of snout toward a line connecting anterior margins of orbits; a band of sharp, backward pointing thorns along margins of disc, beginning opposite anterior edge of orbits and ending about opposite scapular region, the thorns decreasing in size and the band narrowing posteriorly. Two prominent nuchal thorns followed by a naked area and then by a midrow of 47 thorns beginning about  $1\frac{1}{2}$  eye's diameter in advance of axils of pectorals and continuing uninterrupted to first dorsal fin, becoming staggered posteriorly, but in a single row; an additional row of smaller thorns each side of the midrow,

low down on tail, beginning about opposite tips of pelvies and extending nearly to first dorsal where it merges with a band of prickles; all the tail thorns pointing strongly rearward; a single thorn between dorsals. Upper surface of disc (including skin over eyes) covered with minute prickles except along posterior margins and on extreme tip of snout; pelvies naked; tail prickly, everywhere except along the midzone; dorsals densely prickly. Lower surface of disc entirely smooth, but tail covered with minute prickles from about opposite tips of pelvies to opposite origin of second dorsal.

Snout in front of orbits 2.8 times as long as orbit, its length in front of mouth about 2.7 times as great as distance between exposed nostrils. Distance between orbits 0.65 times as great as

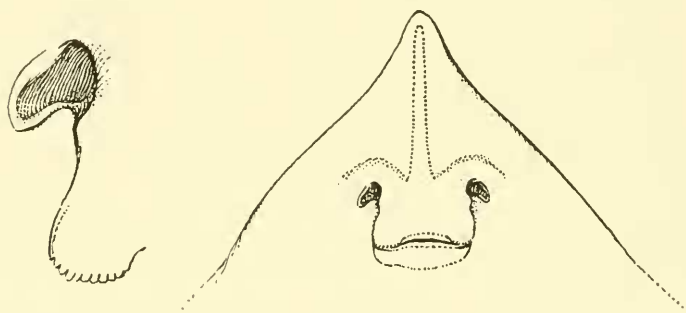


Figure 11. *Cruriraja rugosa*, ventral view of head, about  $\times 0.5$ ; right-hand nostril and nasal curtain, about  $\times 2$ .

length of orbit. Orbit twice as long as spiracle. Nasal curtain with a very short, blunt fringe, expanded outer margins of nostrils smooth, without fringes. Upper and lower jaws nearly short triangular cusp.

Distance between first gill openings twice as great as distance between exposed nostrils; between fifth openings about 1.2 times; first to fourth gill openings about 1.3 times as long as fifth and about 0.25 as long as breadth of mouth. First and second dorsals similar in shape the first slightly the larger. Interspace between dorsals 0.25 times as long as base of first dorsal. Caudal fin very small. Anterior division of pelvies long and slender reaching

beyond tips of posterior lobe when pulled back; posterior lobe with 12 rays, quadrate, the rear margin gently rounded and faintly scalloped, the tips reaching but little beyond rear margin of disc. Claspers failing to reach tips of pelvises by a distance equal to half the diameter of eye.

Rostral cartilage firm, narrow, extending nearly to tip of snout. Anterior pectoral rays reaching 22 per cent the distance from front of orbits toward tip of snout.

*Color.* Upper surface of disc brownish with a bluish tinge, without spots or other markings; tail pale brownish; dorsal brownish with a pale area basally. Below pale bluish on disc, the tail pale brown.

Known only from a single specimen, an immature male 367 mm long, trawled in 200-300 fathoms in the northeastern part of the Gulf of Mexico.

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